

Attorney Docket No.: 0190104

REMARKS

By the present amendment and response, the title has been amended. Figure 3 and claims 2, 4, and 9-10 have been amended. Claims 1-11 are pending in the present application. Reconsideration and allowance of pending claims 1-11 in view of the above amendments and following remarks is requested.

A. Objection to the Drawings

The Examiner has objected to Figure 3 as failing to comply with 37 CFR §1.84(p)(5). As mentioned herein, the attached replacement sheet of drawings includes changes to Figures 3. This sheet, which includes Figures 3-4, replaces the original sheet including Figures 3-4. In Figure 3, reference numeral 10, along with its respective lead line, has been added. Applicant respectfully requests that the objection to the drawings be withdrawn.

B. Objections to the Claims

The Examiner has objected to claims 2 and 4 due to informalities. Applicant has amended claim 2 accordingly. With respect to claim 4, Applicant respectfully submits that "removing unwanted portions of the second pattern to the second coat of photo-resist" does not exist in claim 4 and therefore cannot be changed. However, Applicant believes the Examiner intended to state that "removing unwanted portions of the second coat of photo-resist" should be changed to "removing unwanted portions of the second coat of micro-lens suitable material." Applicant has amended claim 4 accordingly. Consequently, Applicant respectfully requests that the objections to claims 2 and 4 be withdrawn.

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C. Rejection of Claims 1, 3-8, and 11 under 35 USC §102(b)

The Examiner has rejected claims 1, 3-8, and 11 under 35 USC §102(b) as being anticipated by U.S. Patent Number 5,238,856 to Tokumitsu ("Tokumitsu"). For the reasons discussed below, Applicant respectfully submits that independent claims 1, 4, and 11 are patentably distinguishable over Tokumitsu.

The present invention relates to micro-lenses employed in semiconductor devices. As discussed in the present application, one novel aspect of the present invention is a technique of forming micro-lenses in two or more stages. See, for example, page 4, lines 4-5 of the present application. In the various processing stages, a coat of micro-lens suitable material is applied to the surface of a semiconductor circuit. One of a plurality of lens formation patterns is imparted onto the various coats of micro-lens suitable material and a plurality of micro-lenses is formed therefrom. Independent claims 1, 4, and 11 are in concord with such teachings.

It is noteworthy that some conventional approaches involved subjecting micro-lens suitable material to a single lens formation pattern that defined a plurality of "islands." Due to the fact that in conventional approaches formation of the micro-lenses relied on a reflow process, some separation was typically provided between the islands.

However, one factor driving the amount of physical separation required between each individual island of micro-lens suitable material is that of the resolution that may be achieved when the lens formation pattern is imparted onto the material to define island placement. Some amount of image bleeding occurs during this process. Therefore, the amount of space required between the islands of micro-lens suitable material should be great enough to accommodate this inaccuracy.

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Referring to page 11, lines 9-18 of the present application:

“One undesirable artifact of the exposure process is the relatively poor resolving power of the micro-lens suitable material itself. This means that as the micro-lens suitable material is subjected to a lens formation pattern, some amount of bleeding will occur. The lens formation pattern must accommodate this inherent bleeding phenomenon. Accommodation of the bleeding may be accomplished by making the rectangular shapes 20 somewhat smaller than the outer perimeter of the boundary region 5 encompassing each active sensing region 10. This setback precludes the formation of micro-lenses that occupy the entire area defined by the boundary region 5. This results in a diminished efficiency for any micro-lens array fabricated using traditional techniques.” (Emphasis added.)

To this end, the present application utilizes a novel process wherein the micro-lenses are formed in two or more stages. Independent claim 1 recites, for example, “successively applying a plurality of coats of micro-lens suitable material . . . imparted with a succeeding one of a plurality of lens formation patterns”. Independent claim 4 recites, for example, “applying a second coat of micro-lens suitable material. . . imparting a second lens formation pattern . . . forming a second plurality of micro-lenses”. Independent claim 11 recites, for example, “applying a second coat of micro-lens suitable material. . . imparting a second lens formation pattern . . . forming a plurality of micro-lenses from the remaining portions of the first and second coats of micro-lens suitable material”.

In contrast, Tokumitsu simply teaches a method of manufacturing an image pick-up device having at least two photoelectric conversion elements that convert incident light to electric signals. Tokumitsu does not disclose, teach, or even suggest forming micro-lenses in accordance with the teachings of the novel multi-stage process of the present invention. Tokumitsu merely teaches forming first semicylindrical condenser lenses 106 and second semicylindrical condenser lenses 108 on alternate lines over light receiving portions 102. See Figure 7 and column 4, lines 8-31 of Tokumitsu.

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For the foregoing reasons, Applicant respectfully submits that the present invention as defined by independent claims 1, 4, and 11 is not taught, disclosed, or suggested by Tokumitsu. Thus, independent claims 1, 4, and 11 are patentably distinguishable over Tokumitsu. As such, the claims depending from amended independent claims 1, 4, and 11 are, *a fortiori*, also patentably distinguishable over Tokumitsu for at least the reasons presented above and also for additional limitations contained in each dependent claim.

D. Rejection of Claims 2, 9, and 10 under 35 USC §103(a)

The Examiner has rejected claims 2, 9, and 10 under 35 USC §103(a) as being obvious with respect to Tokumitsu in view of U.S. Patent Number 5,604,077 to Kono, et al. ("Kono"). Applicant respectfully submits that claims 2, 9, and 10 depend from independent claims 1 and 4 and thus, claims 2, 9, and 10 should be allowed at least for the same reasons discussed above in conjunction with patentability of independent claims 1 and 4.

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E. Conclusion

Based on the foregoing reasons, the present invention, as defined by independent claims 1, 4, and 11, and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, outstanding claims 1-11 are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early Notice of Allowance directed to all claims 1-11 pending in the present application are respectfully requested.

Respectfully Submitted,
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Date: 6/21/04



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